FermiGrid School

FermiGrid 201
Scripting and running Grid Jobs

Course Outline

- Introduction—Essential definitions and prerequisites
- Using globus-job-run and globus-url-copy
- Using Condor_submit
- Using DAGman
- Use and care of certificates
- Monitoring of grid jobs and problem diagnosis
- Labs

Introduction

- This course will cover examples of submitting jobs from client machine fnpcsrv1 to compute resource fngp-osg
- The examples used here should be good on any Open Science Grid site—but examples of how to identify those sites are beyond the scope of this course.
- You could install your own client on your own machine—future FermiGrid courses will cover how to do this.
- Ask lots of questions—we will fill them in and add them to future issues of the course.
- By the end of this course, you should be able to submit a simple job to the grid, submit a complex job to the grid, and transfer files to the grid resource.

Introduction—Term Definitions

- OSG=Open Science Grid
  - Approximately 80 sites mostly in the United States who share compute and storage resources with each other. Three of those sites are here at FNAL.
- VDT=Virtual Data Toolkit
  - Funded and maintained by the Open Science Grid, this is a one-stop collection of all software needed to run on the Grid.
- Certificate
  - X509 certificates authenticate you to the grid sites. They are signed by a Certificate Authority,
- Proxy
  - A short-lived self-contained representation of your certificate which can be used to submit jobs to the grid
- Globus Toolkit
  - A wide set of services for grid job submissions, file transfer and more.

Before you can submit

- You need:
  - Access to the Open Science Grid (OSG) Client software
    - This software is already installed on fnpcsrv1
  - A personal x.509 certificate
    - All Fermilab staff already have this via the Kerberos Certificate Authority
  - Membership in a Virtual Organization (VO)
    - All Fermilab staff and users are part of the Fermilab VO automatically
  - Some place that will accept the jobs of your VO
    - FermiGrid accepts jobs from all VO's in OSG.

Preparing to submit

- Log into a machine that has the client software on it:
  - Ssh -l <username> fnpcsrv1.fnal.gov
- Source the setup file
  - Source /usr/local/vdt/setup.sh
- Obtain a Fermilab KCA certificate
  - Kx509
  - Kxlist -p
- Get the certificate signed by the Fermilab VOMS server
  - Voms-proxy-init -noregen -voms fermilab:/fermilab
- Verify that the voms-proxy-init worked
  - Voms-proxy-info -all

Preparing to submit—sample output

```
bash-3.00$ source /usr/local/vdt/setup.sh
bash-3.00$ kx509
bash-3.00$ kxlist -p
Service kx509/certificate
 issuer= /DC=gov/DC=fnal/O=Fermilab/OU=Certificate Authorities/CN=Kerberized CA
 subject= /DC=gov/DC=fnal/O=Fermilab/OU=People/CN=Steven C. Timm/UID=timm
 serial=7E6C63
 hash=03c202fc
bash-3.00$ voms-proxy-init -noregen -voms fermilab:/fermilab
Cannot find file or dir: /home/condor/execute/dir_11128/userdir/glite/etc/vomses
Your identity: /DC=gov/DC=fnal/O=Fermilab/OU=People/CN=Steven C. Timm/USERID=timm
Cannot find file or dir: /home/condor/execute/dir_11128/userdir/glite/etc/vomses
Contacting  voms.fnal.gov:15001 [/DC=org/DC=doegrids/OU=Services/CN=http/voms.fnal.gov] "fermilab" Done
Creating proxy ..................................... Done
Your proxy is valid until Tue Feb 26 07:41:27 2008
```

- Comments—The warning about missing /home/condor directory is routine
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How did you know it worked?

```
bash-3.00$ voms-proxy-info -all
WARNING: Unable to verify signature! Server certificate possibly not installed.
Error: Cannot find certificate of AC issuer for vo fermilab
subject   : /DC=gov/DC=fnal/O=Fermilab/OU=People/CN=Steven C. Timm/USERID=timm/CN=proxy
issuer    : /DC=gov/DC=fnal/O=Fermilab/OU=People/CN=Steven C. Timm/USERID=timm
identity  : /DC=gov/DC=fnal/O=Fermilab/OU=People/CN=Steven C. Timm/USERID=timm
type      : proxy
strength  : 512 bits
path      : /tmp/x509up_u2904
timeleft  : 10:41:35
=== VO fermilab extension information ===
VO        : fermilab
subject   : /DC=gov/DC=fnal/O=Fermilab/OU=People/CN=Steven C. Timm/USERID=timm
issuer    : /DC=org/DC=doegrids/OU=Services/CN=http/voms.fnal.gov
attribute : /fermilab/Role=NULL/Capability=NULL
timeleft  : 10:41:35

bash-3.00$
```

Error message about server certificate above can be ignored

What if voms-proxy-init didn't work

```
bash-3.00$ voms-proxy-init -noregen -voms cms:/cms
Cannot find file or dir: /home/condor/execute/dir_11128/userdir/glite/etc/vomses
Your identity: /DC=gov/DC=fnal/O=Fermilab/OU=People/CN=Steven C. Timm/USERID=timm
Cannot find file or dir: /home/condor/execute/dir_11128/userdir/glite/etc/vomses
Contacting  lcg-voms.cern.ch:15002 [/DC=ch/DC=cern/OU=computers/CN=lcg-voms.cern.ch] "cms" Failed
Error: cms: User unknown to this VO.
Trying next server for cms.
Contacting  voms.cern.ch:15002 [/DC=ch/DC=cern/OU=computers/CN=voms.cern.ch] "cms" Failed
Error: cms: User unknown to this VO.
None of the contacted servers for cms were capable
of returning a valid AC for the user.
```

- Above is error message that happens if you are not in the VO
- Check by going to voms server https://voms.fnal.gov:8443/voms/fermilab
- Voms-proxy-init -debug is your friend
- To join a VO that you're not in now, use VOMRS to request membership.

Lab 1

- Use the kx509/kxlist -p /voms-proxy-init sequence to get a good voms proxy.
- Show the instructor when you are ready.

Grid job submission in English

- There is a submission machine and a compute element.
  - In this example, fnpcsrv1=submission machine, fngp-osg=compute element
- Client side authenticates to the compute resource
  - Using your certificate and the machine's certificate to make a SSL connection
- The executable and input files are transferred to the compute resource
  - By opening an https: connection
- The executable is submitted to the batch system on the compute resource
  - Using the GRAM interface
- When the job completes, the output files are transferred back
  - Again using an https: port

Test submit: Globus-job-run

- Example
  - Globus-job-run fngp-osg.fnal.gov:2119/jobmanager-fork /usr/bin/id
- Structure of the example:
  - Host:port to submit the job to.
    - 2119 is the default port and can be omitted
  - Which jobmanager to use.
    - Jobmanager-fork is usually the default. Others available, we will cover.
  - Command to use
    - This structure will run the /usr/bin/id that's already on the remote machine.
- Comments
  - Globus-job-run should be used only for diagnostic purposes
  - One daemon per globus-job-run is launched on the remote machine and stays running until it exits—or sometime hangs.

Test transfer: globus-url-copy

- Globus-url-copy is the command-line client for GRIDFTP
- Example:
  - Globus-url-copy file://${HOME}/foo gsiftp://fngp-osg.fnal.gov/grid/data/foo.${USER}
- Comments:
  - Globus-url-copy is for small files and light testing
  - In the above example, the environment variables are evaluated on submit machine
  - Works to go to compute elements or storage elements
  - For big data flows use srmcp, covered this afternoon
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Lab 2

- Execute the following sequence:
- Globus-job-run fngp-osg.fnal.gov:2119/jobmanager-fork /usr/bin/id
- Globus-url-copy file://${HOME}/helloworld.sh gsiftp://fngp-osg.fnal.gov/grid/data/helloworld.sh.${USER}
- Globus-job-run fngp-osg.fnal.gov:2119/jobmanager-fork /bin/chmod 755 \ /grid/data/helloworld.sh.${USER}
- Globus-job-run fngp-osg.fnal.gov:2119/jobmanager-fork \ /grid/data/helloworld.sh.${USER}

Condor submission concepts in English

- Condor is comprehensive batch system and grid submission software
- Grid submission client components are called Condor-G
- Have to install all of Condor to use the Condor-G clients.
- Condor-G runs on the submission host and
  - Transfers your executable and input files to remote compute element and gets it started
  - Monitors the status of the job every minute to see if it is done
  - Transfers the files back when the job is over.

Condor submission—simple example

```
universe = grid
type = gt2
globusscheduler = fngp-osg.fnal.gov/jobmanager-condor
executable = recon1
transfer_output = true
transfer_error = true
transfer_executable = true
stream_output = false
stream_error = false
log = grid_recon1.log.$(Cluster).$(Process)
notification = NEVER
output = grid_recon1.out.$(Cluster).$(Process)
error = grid_recon1.err.$(Cluster).$(Process)
globusrsl = (jobtype=single)(maxwalltime=999)
queue
```

Grid universe for all jobs

type gt2 refers to version 2 of Globus

recon1 is a binary that will run for 3 minutes

To submit it:

condor_submit grid_recon1

Transferring input and output files

```
bash-3.00$ more fngp-osg-gridsleep-fourargs
Universe = grid
remote_initialdir = /grid/data/foo
GridResource = gt2 fngp-osg/jobmanager-condor
executable = gridsleep.sh
# Old style of condor arguments
arguments = one two three four
transfer_output = true
transfer_error = true
transfer_executable = true
stream_output = False
stream_error = False
should_transfer_files = YES
when_to_transfer_output = ON_EXIT_OR_EVICT
transfer_input_files = foo
transfer_output_files = bar
log = gridsleep.log.$(Cluster).$(Process)
notification = NEVER
output = gridsleep.out.$(Cluster).$(Process)
error = gridsleep.err.$(Cluster).$(Process)
globusrsl = (condorsubmit=(requirements 'Disk>5000'))
queue 1
```

Lab 3

- Submit the jobs grid_recon1 and fngp-osg-gridsleep-fourargs
- Monitor their progress with condor_q and condor_q -globus
- Record any errors

Globus RSL

- RSL=Resource Specification Language
- The way to communicate requirements to the remote batch system
- Can be used to set memory, wall time, processor type, architecture, and more. We have examples

Condor DAGman

- DAG=Directed Acyclic Graph
- Used to show dependencies—to make one job not start until its predecessor is completed.
- Example is provided in the example tarball, we will go through it if we have time.

Using DOEGrids Certificates

- Why get a DOEGrids cert? (see http;//security.fnal.gov/pki for full explanation)
- Store your DOEGrids cert and private key—on some non-network-mounted disk.

Monitoring of Grid Jobs

- Globus GRAM is meant to hide the remote batch system details from the submitting host. It is **very** good at this.
- condor_q
- condor_q -globus
- condor_q -held
- CondorView
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Problem diagnosis

- Globus error 7—authentication, at Fermilab usually a problem with SAZ or GUMS
- Globus Error 10—failure to transfer file, means something is out of quota somewhere.
- Globus error 155—failure to stage out—happens when proxy expires before end of job
- Globus error 17—either the executable isn't there or there is something wrong with the batch system.